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SOME UPPER CRETACEOUS AMMONITES FROM ANGOLA

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INTRODUCTION

The six ammonites described in this paper are believed to have been collected by Dr. Chester W. Washburne, while engaged in geological exploration in Angola some twenty to thirty years ago. Four of them are in the collections of The American Museum of Natural History; they are marked with the field locality number "3095." According to the copy of the field label found with one of the specimens, this locality is north of Cabiri,[1] a place about 45 km. east southeast of Loanda in northern Angola. The two remaining ammonites were located by the writer in the Geological Collections of Johns Hopkins University; by the records of this institution they too were collected, among other fossils, by Dr. Washburne "about 1914–1915," but the exact locality where they were found is unknown. Owing to their close relationship to the *Texanites* described from "3095" they are included in this paper.

I wish to express my gratitude to the Geological Department of Johns Hopkins University, particularly to Dr. Charles T. Berry, for the loan of these two specimens and for permission to describe and figure them; to Mr. W. B. Heroy, Chief Geologist, Consolidated Oil Corporation, for valuable information as to the origin and the localities of these and some other ammonites and other Angola fossils in the collections of the American Museum; and to Dr. Harold E. Vokes, Assistant Curator of Invertebrate Palaeontology, American Museum, for revision of this manuscript.

The ammonites here dealt with were studied in the course of the preparation of Part I of the writer's paper on "The Vernay Collection of Cretaceous (Albian) Ammonites from Angola,"[2] and for discussion of taxonomic issues, for terminology and for previous literature on the geology and palaeontology of the Cretaceous of Angola reference is made to that paper.

It is hoped to describe, at a later date, some other interesting Upper Cretaceous ammonites from northern Angola, all of which are irregularly coiled forms.

Owing to the size of the specimens, all figures, except two suture line drawings, had to be reduced, some even to one-third. The drawings, for this paper too, were made by Miss Helen Babbitt.

GENUS ACANTHOCERAS NEUMAYR

SUBGENUS ROMANICERAS SPATH

Since Neumayr (1875, p. 929) created his genus *Acanthoceras*, so many forms belonging to it have become known that many authors endeavored to distinguish various groups within this large genus. Among those de Grossouvre (1893, pp. 26, 27), Pervinquière (1907, pp. 258, 259), Henri Douvillé (1911, pp. 296–300), Spath (various papers) and, recently, Collignon (1937, pp. 60–65) must be mentioned.

In 1923 (p. 144) Spath proposed the generic name *Romaniceras* for the Turonian *Ammonites deverianus*[3] d'Orbigny (1841, p. 356, Pl. cx), discussed, a few years ago, most explicitly by Basse (1937, p. 180, Pl. VIII, figs. 1, 2). However, neither she

[1] The name "Itombe," preceding the above indication of the locality on the label, is a formation name used by Dr. Washburne, but, as far as the writer knows, found in literature solely in the data given by Haughton (1924, p. 101) on the occurrence of his new species *Epiaster angolensis*.

[2] Awaiting publication in the Bulletin (A. M. N. H.).

[3] Quoted as "*A. Deveriae*" by H. Douvillé (1911, p. 297) and as "*A. Deveriai*" by de Grossouvre (1889, pp. 524, 525; 1893, p. 141) and Collignon (1937, pp. 60, 64).

nor, as far as the writer knows, any other author ever used Spath's generic name. When creating it he did not give any generic diagnosis; the chief distinctive feature of *Romaniceras* is apparently, as stated also by Roman (1938, p. 435), the presence of nine, or even eleven, rows of tubercles instead of seven, as is the rule in *Acanthoceras, s. str.* (cf. Kossmat, 1898, p. 5[1]).

The only *Acanthoceras* found at locality "3095," as described below, clearly exhibits nine rows of tubercles, thus betraying its close relationship to *A. deverianum.* In spite of the writer's general aversion to subgeneric names *"Romaniceras"* is added in parentheses to the generic name *Acanthoceras* in this particular case, just to indicate that within *Acanthoceras, s. l.*, the present form belongs to the group of *Ammonites deverianus.* The issue as to whether *"Romaniceras"* deserves to be considered an independent genus, as proposed by Spath, or can be kept merely as a subgenus of *Acanthoceras, s. l.*, cannot be solved in the present paper.

Acanthoceras (Romaniceras), spec. indet.

Figures 1 and 2

A. M. N. H. No. 25194: one specimen

DIMENSIONS[2]

D	H[3]	H'[3]
ca. 190 mm.	71 mm.	ca. 60 mm.
W[3]	W'[3]	U
61 mm.	68 mm.	ca. 65 mm.

DESCRIPTION.—The single specimen, a cast, consists of somewhat more than a third of an outer whorl; only its foremost part belongs to the body chamber.

The conch is but moderately involute; the impressed zone occupies about a sixth of the height of the outer whorl. The intercostal section (Fig. 1) is inverted heart-shaped, the costal one (Fig. 2c) hexagonal; there is one edge at about the second third of the sides, marked by the second lateral row of tubercles, and another, the latero-ventral one, marked by the third row. The venter is flat, if the median tubercle is not taken into account. The section has its greatest width somewhat above the umbilical shoulder which is pronounced, though rounded. The umbilical wall is rather high and steep, almost perpendicular.

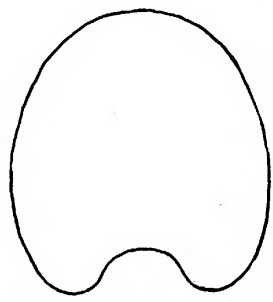


Fig. 1. Intercostal section of *Acanthoceras (Romaniceras)*, spec. indet., A. M. N. H. No. 25194, × 1/2.

There are five straight, radial, prominent ribs per quarter whorl. The last four ribs, visible on the right side of the fragment only, seem to be alternately long and short, whereas the first three appear to be uniform. On the venter the costae are reduced to blunt, broad folds which are separated from each other by broad, moderately deep interstices. The ribs are reinforced by four rows of tubercles on each side, and there is a median one on the venter. The innermost row is on the umbilical wall; these tubercles are decidedly bullate. The first lateral row consists of radially elongated tubercles, covering the inner third of the ribs. The tubercles of the second lateral row are at about the second third of the sides; they are by far the strongest and are slightly elongated in the spiral sense. The tubercles of the third lateral row, accentuating the latero-ventral shoulders, are still more elongated spirally. The same is true of the median ones; they are

[1] "... mit 7 Knotenreihen versehen, wie die übrigen *Rhotomagensis*-Formen" (in description of *A. newboldi, forma typica*).

[2] In the tables of dimensions "D" means the greatest diameter that could be measured, "H" the height of the last whorl from the umbilical seam to the periphery, "H'" its height from the dorsum to the periphery, "W" the width of the intercostal (internodal) section of the last whorl, "W'" that of the costal (nodal) one, "U" the width of the umbilicus. "D" is always expressed in mm.; the other dimensions are, unless otherwise noted, expressed in per cent of "D" or, if that proved to be impossible, of a smaller diameter which is, in such cases, explicitly indicated. In these percentage figures decimals have been reduced or increased, respectively, to full or half per cent.

[3] Measured at about the middle of the fragment.

the culminating points of the folds which connect the external ends of the ribs across the venter. They exceed, however, the stems, which are each bifid, are about equally high and broad. The first lateral lobe is about half as broad as the external

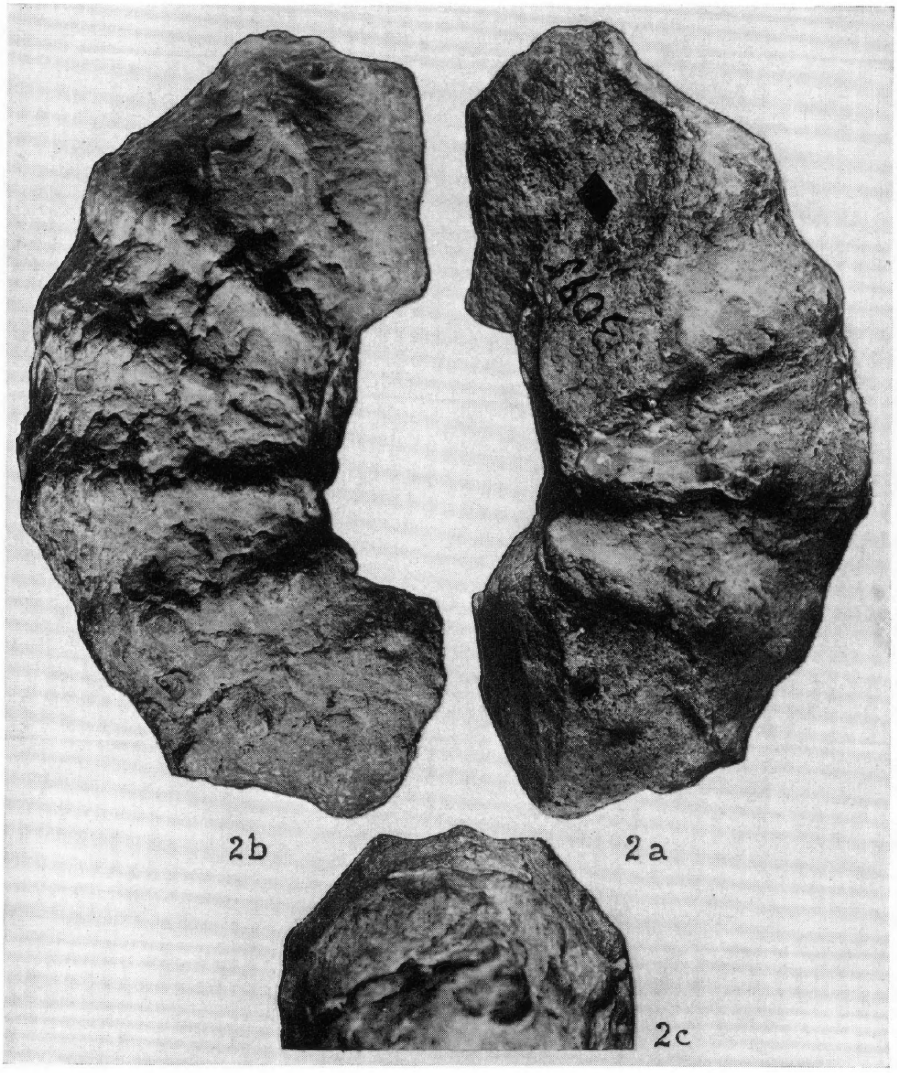


Fig. 2. *Acanthoceras* (*Romaniceras*), spec. indet., A. M. N. H. No. 25194. (a) Left, (b) right sid view, both × 1/2. (c) Oblique-ventral view, showing outline of upper half of costal section, × ca. 3/4.

external tubercles but slightly in height (Fig. 2c).

On the right side of this fragment the rough outlines of the suture line could be studied; they are, however, too poor for delineation, as the surface is very weathered. The external saddle is very broad and deeply intersected by a lobule; its two saddle, comparatively short and apparently bifid. Also the first lateral saddle is very broad, though less so than the external one, and higher than the latter; both its stems are bifid, the inner one is much broader and higher than the outer one. The second lateral lobe is far shorter than the first; it seems to be triangular in shape

and three-pronged. The second lateral saddle is on the umbilical wall.

OCCURRENCE.—Locality "3095," north of Cabiri.

REMARKS.—This form resembles, in side view, Defrance's type of *Ammonites rhotomagensis*, the genotype of *Acanthoceras, s. str.*,[1] as refigured by Roman (1938, p. 434, Pl. XLIV, fig. 417), but the latter, besides having only seven rows of tubercles, has a depressed, transversely rectangular section and a much broader, truncate venter. From d'Orbigny's (1841, Pl. CX) protograph of *Ammonites deverianus* the example here dealt with differs by its larger size, by its less stout whorls and by having much fewer and stronger ribs which never bifurcate at the first third of the sides. These differences are less obvious if the "cotypes" of d'Orbigny's species recently figured by Basse (1937, Pl. VIII, figs. 1, 2), the sculpture of which is far more robust than that seen in d'Orbigny's figure, are compared with the Angola example, but the latter cannot be considered to be conspecific with them.

Ammonites deverioides de Grossouvre (1889, p. 524, Pl. XII, figs. 1, 2) from the Turonian of the Paris Basin resembles the present form in section, but it differs by having eleven instead of nine rows of tubercles, by its denser costation and by the regular intercalation of one or two (exceptionally even three) secondary ribs between the primary ones.

Basse's (1937, p. 180, Pl. IX, fig. 1) *Acanthoceras* cf. *deverianum* from the Turonian of the Lebanon attains about the same size as the Angola specimen, and both shape of conch and character of costation are not so different in side view, but it differs greatly in the lack of any tubercles in maturity and in the fact that its ribs cross the venter uninterruptedly.

The only ammonite of the *deverianus*-group hitherto recorded from Africa is, as far as the writer knows, *Acanthoceras* cf. *deverianum*, described but unfortunately not figured by Pervinquière (1907, p. 272) from the "uppermost Turonian, or rather owermost Senonian" of Tunis; this reference is, however, questioned by Basse (1937, p. 182).

Of the two Acanthoceratids described from the Upper Cretaceous of Angola by Douvillé (1931) that one referred by him to *Acanthoceras lyelli* Leymerie[2] (p. 31, Pl. I, fig. 1), but renamed *Protacanthoceras angolaense* by Spath (1931, p. 316), has a similar habitus and also distinct tubercles on the umbilical wall, but only seven rows of tubercles and, according to Douvillé's description, an almost circular section;

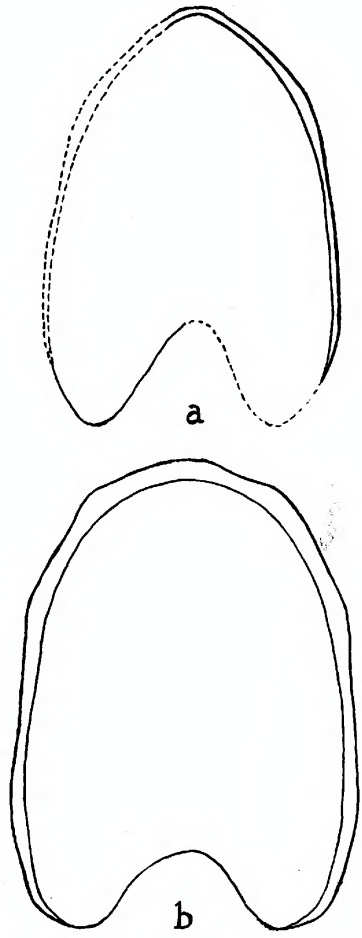


Fig. 3. Costal and intercostal sections of *Mantelliceras* (?), spec. indet., A. M. N. H. No. 25195. (a) At posterior, (b) at anterior end of fragment, both × 1/2.

[1] This is denied by Jacob (1908, pp. 377–378, footote 2).

[2] This species was made the genotype of *Lyelliceras* by Spath (1921a, p. 220; 1922a, p. 107; 1931, p. 315).

moreover, its costation is a little more dense and its ribs are hardly reduced on the venter. This ammonite certainly cannot be included in the *deverianus*-group. The same is true of Douvillé's other Angola form, named by him *Acanthoceras borgesi*

Dimensions		
D	H	H′
?	115 mm.	ca. 90 mm.
W	W′	U
ca. 80 mm.	ca. 90 mm.	?

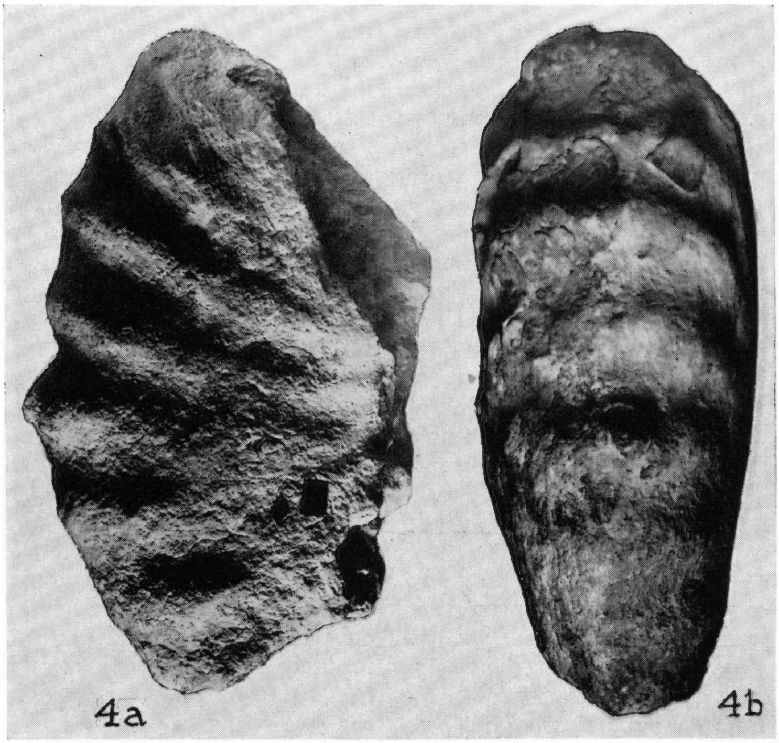


Fig. 4. *Mantelliceras* (?), spec. indet., A. M. N. H. No. 25195. (a) Right side view, (b) ventral view, both × 1/2.

(1931, p. 32, Pl. II, figs. 3, 4), but referred by Spath (1931, p. 316), in the writer's opinion justly, to *Metacalycoceras;* it is far more globose and more densely ribbed than the form under discussion and shows only circum-umbilical tubercles.

Genus **Mantelliceras** Hyatt

A single fragment is, though doubtfully, referred to this genus (Hyatt, 1903, p. 113; genotype: *Ammonites mantelli* J. Sowerby, 1812, p. 119, Pl. LV).

Mantelliceras (?), spec. indet.

Figures 3 and 4

A. M. N. H. No. 25195: one specimen

Description.—A very worn fragment of a cast, with a few remnants of the shell, consists of about a quarter of an unseptate whorl and corresponds to a diameter of the disc of about 350 mm.

The impressed zone amounts, at the posterior end of the fragment, to almost a fourth of the height of the outer whorl; thus the conch must have been rather involute. The section (Fig. 3a, b) is comparatively slender and subelliptical; it attains its maximum width at about the first fifth of its height. The sides are almost flat, though slightly converging ventrad. In sectional view the venter appears to be ogival at the posterior end, but almost

semicircular at the anterior one; it seems to have been even more ogival in the penultimate whorl. The umbilical shoulder is broadly rounded, the umbilical wall steep, though not perpendicular.

There are eight single, straight, radial ribs per quarter whorl; they are preserved as indistinct folds on the inner zone of the sides and become gradually more prominent on the outer one, but even there they remain broad and blunt, their section being semicircular. They cross the venter uninterruptedly, thus causing it to look undulate in side view. The ribs carry more or less indistinct tubercles slightly beneath the first third and at the third quarter of the sides, along the latero-ventral shoulders and along the median line; those at the third quarter of the sides are apparently the strongest. Preservation does not permit to decide whether or not there are faint tubercles also on the umbilical edges (in which case there would be nine rows altogheter, as in the subgenus *Romaniceras*).

OCCURRENCE.—Locality "3095," north of Cabiri.

REMARKS.—As only a part of the body chamber of a large adult is preserved, the generic assignment of this fragment was not easy. The ribs crossing the venter uninterruptedly are a generic character of *Metacalycoceras* Spath (1926, p. 83; cf. Adkins, 1928, p. 241; = *Calycoceras* Hyatt, 1903, p. 113, *pro parte*. The latter name has, however, to be canceled as a synonym of *Mantelliceras*). The genotype of *Metacalycoceras*, *Ammonites mantelli* d'Orbigny (1840, p. 341, *pro parte*, Pl. CIII only), *non* Sowerby, is, however, so much more globose and semicircular in section that the present fragment can by no means be referred to that genus. As continuity of the costae across the venter is also found in large adults of *Mantelliceras* (cf. Hyatt, 1903, p. 113; Roman, 1938, p. 436[1]), it seemed to be more advisable to refer this specimen, though doubtfully, to the latter genus. Indeed, its ribs crossing the venter quite uninterruptedly strongly resemble those of an adult individual from the Cenomanian of Tunis, referred by Pervinquière (1907, pp. 289, 291, Pl. XVI, fig. 18) to the same group of *Ammonites mantelli* and considered by him to be transitional between Sowerby's species and *Ammonites martimpreyi* Coquand. His form is, however, much smaller and a little more densely ribbed than the Angola specimen; that the costae appear to be less distinct on the latter's sides may be due to its apparently being much more worn laterally than ventrally.

None of the various *Mantelliceras* recorded from Madagascar by Boule, Lemoine and Thevenin (1906–1907, pp. 29, 30, Pl. VIII, figs. 3, 4, 9) and by Collignon (1929, pp. 33–37, Pl. III, figs. 2–17; 1931b, pp. 39–43, Pl. IV, figs. 3–12; 1933, p. 64, Pl. V, figs. 3–6; 1937, pp. 53–58, Pl. IV, fig. 5, Pl. VII, figs. 1–7, Pl. IX, figs. 6–9) is so similar to the present fragment as to require comparison.

On the other hand, the latter resembles, in ventral view, the *Metacalycoceras* (?) sp. 1 of Adkins (1928, p. 242, Pl. XXVII, fig. 1)[2] from the Eagle Ford (?) of Texas, previously described by Lasswitz (1904, p. 18) under the name of *Acanthoceras mantelli*. Unfortunately Adkins figures this form only in ventral view, so that it cannot properly be compared with the present one. However, all the forms referred to the genus *Metacalycoceras* by Adkins appear to be considerably less involute than the former.

The only *Mantelliceras* hitherto recorded from Angola is that one mentioned by Haughton (1924, p. 89); it cannot be compared with the form under discussion, which is eight to nine times as large, as the former has not been figured. However, it is certainly different, as its whorls are wider than high. Furthermore, the occurrence of an example referred to the Cenomanian genus *Mantelliceras* together with forms of the Upper Albian fauna of Angola, e.g., *"Inflaticeras" gregoryi* Spath and *Prohysteroceras wordiei* Spath, as recorded by Haughton (*op. cit.*, p. 80), seems rather strange.

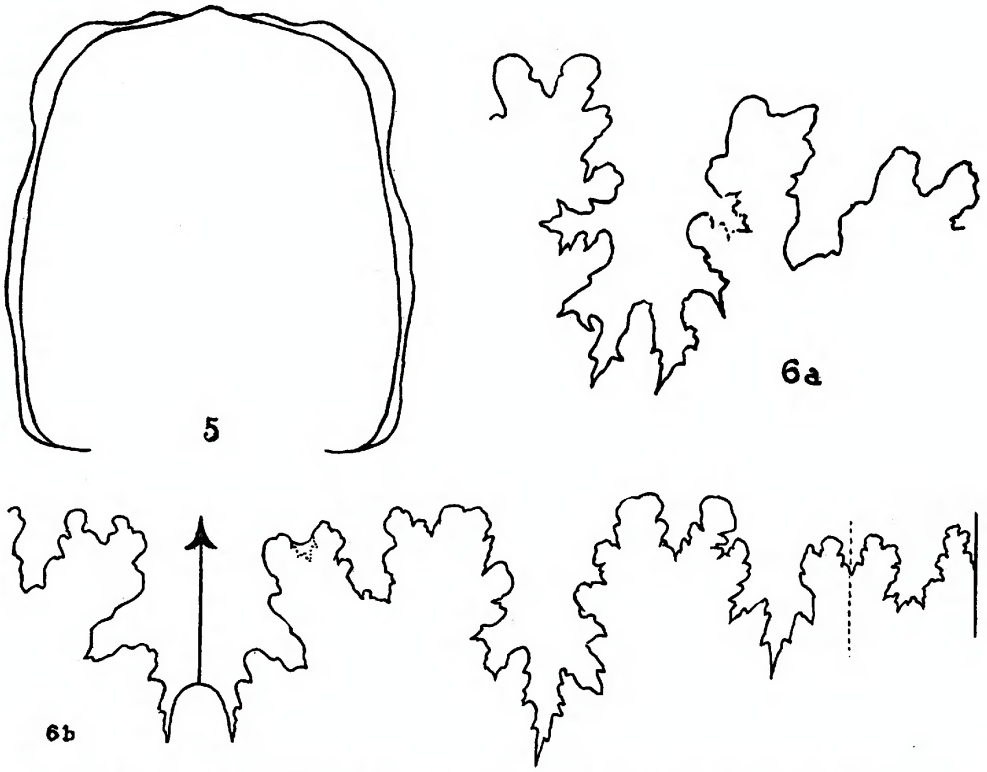
[1] "Dans la forme gérontique les tubercules disparaissent et les côtes passent sans interruption sur la région externe."

[2] This author's description states the ribs to be nontuberculate, but his figure seems to show median tubercles as well as rows of tubercles along both latero-ventral shoulders.

From the only form of the present collection which, although referred to another genus, might be considered for comparison, *Acanthoceras* (*Romaniceras*), spec. indet., this fragment can readily be distinguished by its much less distinct tubercles on the body chamber and by its ribs crossing the venter uninterruptedly.

	W	W′	U
At last septum	?	37.5	32.0
At anterior end	29	—	33.5

Description.—The unique specimen is the largest of the present collection; it even exceeds all ammonites ever recorded from Angola in size. It is a very worn cast and, although a full disc, is not complete, for only a third of its last whorl belongs to the body chamber. The shell



Figs. 5, 6. *Sharpeiceras goliath*, new species, holotype, A. M. N. H. No. 25196. (5) Section near last septum, × 1/2. (6) Suture lines: (a) first lateral lobe and parts of adjacent saddles at D = ca. 150 mm. (left side), natural size; (b) at D = ca. 250 mm., × 2/3; siphonal lobe supplemented after a smaller, less corroded suture line.

Genus **Sharpeiceras** Hyatt

A single specimen is referred to this genus (Hyatt, 1903, p. 111).

Sharpeiceras goliath, new species

Figures 5, 6, 7

A. M. N. H. No. 25196: one specimen

Dimensions of Holotype

	D	H	H′
At last septum	265 mm.	39	?
At anterior end	342 "	41	32

must have been very thick, as seen in frontal view (Fig. 7c) from the interstice of 7.5 mm. between the casts of the outer whorl and of the penultimate one.

The conch is but moderately involute; at the anterior end less than a third of the penultimate whorl is embraced by the last. A slight egression of the spiral of involution is perceptible in the anterior part of the outer whorl.

At the end of the penultimate one the sectional outline of the cast appears to be almost trapezoidal; the sides are but gently vaulted and converge slightly ventrad. The venter appears concave, its median part being occupied by a

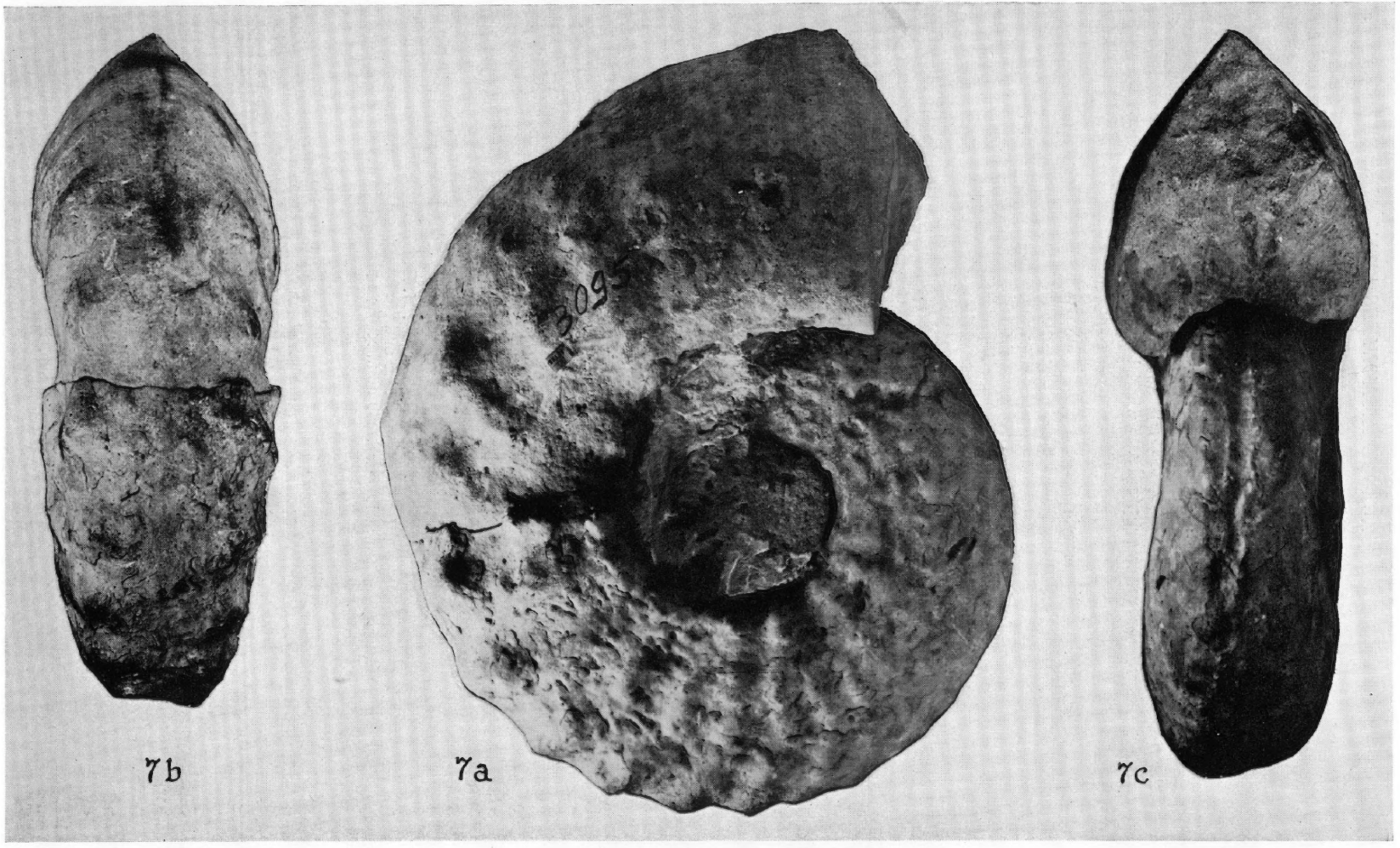


Fig. 7. *Sharpeiceras goliath*, new species, holotype, A. M. N. H. No. 25196. (a) Right side view, (b) ventral view, (c) frontal view, all × 1/3.

rather broad channel which is semicircular in section and accompanied by a broad torus on each side. An examination of the impressed zone of the outer whorl at its anterior end proves, however, that the penultimate one had a very broad and blunt keel above a truncate venter. The almost circular gap between the impression of that keel and the aforementioned channel, as seen in Fig. 7c, thus marks the place of the siphuncular tube. The umbilical shoulder is rounded, the umbilical wall high but not very steep.

In the foremost portion of the septate part of the conch the upper part of the section (Fig. 5) is decidedly trapezoidal; the umbilical wall has become very high and almost perpendicular, the venter very broad and flat. The channel has disappeared; here and there a low, hardly perceptible, median ridge, indicating the keel, can be seen even on the cast.

In the body chamber the section is entirely altered. The median ridge becomes gradually higher and sharper, developing into a slightly undulate crest. The outer part of the whorl becomes decidedly fastigate. At the anterior end the section (Fig. 7c) is rounded-triangular; the sides are vaulted only in their middle zones and converge ventrad at an angle of less than 60°. Thus the conch assumes a "galeate" shape (Fig. 7a, b).

In spite of the worn condition of the surface, distinct costae can be seen on the septate part of the specimen, best in the second third of the outer whorl, whereas they are corroded farther apicad. There seem to be from eleven to thirteen ribs per half whorl; some of them are single, some bifurcate at the circum-umbilical nodes. The ribs are slightly sinuous, forming an orad concave arc, and are prorsiradiate. The costation becomes gradually less dense toward the body chamber.

There are four rows of tubercles on each side: one, consisting of rather strong tubercles, at the umbilical shoulder, a second at about the first third of the sides, a third on their outer zone close to the latero-ventral edge and a fourth at this very edge. Sometimes one more small tubercle seems to be intercalated between those of the second row and the third, but preservation does not permit a decision as to whether or not they form a fifth row. Furthermore, the tubercles of both the first and the second rows seem to be notched occasionally. At the last septum the tubercles of the second row have become the strongest and are radially elongated. Simultaneously those of the two outermost rows coalesce with each other to form large, though blunt, horn-like nodes which point upward in ventral view and upward and sideward in sectional view, and another blunt node is intercalated on both sides of the venter between these "horns" and the median ridge (Fig. 5).

On the body chamber the ornament fades rather suddenly. There are but a few very indistinct folds, reminiscent of the ribs, and two large, blunt horns at the site of the former latero-ventral shoulder, which are, owing to the sudden fastigating of the periphery, very distant from the top of the crest. In its foremost part the shell is entirely smooth.

Many suture lines could be examined, but all are more or less weathered (Fig. 6b). The siphonal lobe is comparatively broad and shallow; its two terminal points seem to be rather short and are separated from each other by a low median knob; immediately above them are two large, oblique, lateral branchlets, deeply intersecting the outer margins of the external saddles. The latter are very broad and subdivided by a large, deep, dorsad-inclined, three-pronged lobule; both main stems of this saddle are intersected by short, trifid lobules; the inner one is considerably broader and higher than the outer one. The first lateral lobe is deeper than the siphonal one; as seen in a suture line at the beginning of the outer whorl, less corroded than the others (Fig. 6a), this lobe is subdivided by a strong, upright leaf into two almost parallel, strong terminal points which seem to be each three-pronged. On the right side of the conch, however, the outer one of these two terminal points develops so much stronger than the inner one that the first lateral lobes of subsequent suture lines appear more and more trifid rather than bifid. It cannot be reliably decided how far this aspect is due to differences in corrosion. The first lateral saddle is higher than the external one, broad and bifid, with its outer stem broader than the inner one. The second lateral lobe is comparatively broad, shorter than both the first and the siphonal lobe, and trifid. The second lateral saddle is low and broad; the three-pronged lobule subdividing it is situated at the umbilical edge. There follow, on the umbilical wall, the first auxiliary lobe, which is short, three-pronged and slightly inclined ventrad, a slender auxiliary saddle, which is remarkably higher than the second lateral one, and half of a second auxiliary lobe.

It is worth noting that the site of the saddles coincides with the tubercles. As long as those of the third and fourth rows are separated, each of them corresponds to one stem of the external saddle; after their coalescence, however, they are covered by its median lobule and its inner stem. The tubercles of the second row coincide with the first lateral saddles, the umbilical ones with the second lateral saddles. Where a notch can be observed in the tubercles of the second row, it occupies exactly the place of the lobule intersecting the first lateral saddle.

OCCURRENCE.—Locality "3095," north of Cabiri.

REMARKS.—Among the known species of *Sharpeiceras*, *S. florencae* Spath (1925, p. 198, Pl. XXXVII; Collignon, 1933, p. 67, Pl. VI, fig. 5) from the Cenomanian of Maputoland, South Africa, and of Madagascar appears to be most closely related

to this new form. The measurements are about the same, and also Spath's species shows a remarkable decrease in density of costation toward the body chamber and a similar arrangement of the tubercles; also in *S. florencae* the two outermost ones coalesce in maturity into a large horn. Furthermore, both species agree in the general plan of the suture lines. It is true that the venter of Spath's holotype is still decidedly concave at a diameter of 160 mm. and does not show any trace of a keel even at 215 mm., whereas the keel is quite distinct in the present species at about 170 mm. diameter. On the other hand, Douvillé's (1904, p. 239, Pl. XXXI, fig. 3) "*Acanthoceras laticlavium* Sharpe" from Persia, which is so closely related to *S. florencae* as to be considered conspecific by Spath, has "un pli assez regulier dans la région siphonale qui simule presque une carène" (visible also in Douvillé's side view) at as small a diameter as 115 mm. This seems to prove that maturity, along with the development of a keel, is reached within this genus at different sizes.

The ventral crest and the loss of costation on the body chamber are obviously features of the gerontic stage of this genus, stated to be unknown by Roman (1938, p. 438). On the other hand, *S. laticlavium* var. *mocambiquensis* Choffat (1903, p. 25, Pl. IV, fig. 3, Pl. VII, fig. 2) from the Cenomanian of Mozambique, raised to the rank of an independent species by Spath (1925, p. 199), does not exhibit any of these characters at a still larger size (diameter about 450 mm.) and thus seems to give further evidence of their appearance at very different stages and sizes. Choffat's form agrees in its measurements fairly well with the Angolan one, except for the slightly narrower umbilicus, but its ribs seem to be sharper and narrower, and its section has its greatest width in the middle, not near the umbilical edge as does that of *S. goliath.*

It may be noted that the holotype of *Ammonites laticlavius* Sharpe (1854, p. 31, Pl. XIV, fig. 1), although far smaller than the present example, also shows, according to Spath (1925, p. 198, footnote 3), "a median raised line of the venter which is almost a keel." That of the new species here dealt with can, therefore, not be thought to be in the way of the chosen generic assignment, as *S. laticlavium* is the genotype.

However, neither that holotype nor Kossmat's (1895, p. 199, Pl. XXIV, figs. 5, 6) var. *indica* of Sharpe's species (= *S. indicum* Spath, 1925, p. 199), nor the form described and figured as *Ammonites laticlavius* by Schlüter (1871, p. 18, Pl. VII, figs. 4–8), but renamed *Sharpeiceras schlueteri* by Hyatt (1903, p. 111), is very similar to the species under discussion. Another species of Schlüter's (1871, p. 7, Pl. III, figs. 1–5), which Hyatt (1903, p. 111) refers to the same genus, *Ammonites inconstans*, is remarkable for exhibiting the same fading of ornamentation on the body chamber as the present example.

Except for *S. florencae* and *S. mocambiquensis*, compared above, the African forms of this comparatively rare genus do not resemble that from Angola. The reference of "*Acanthoceras laticlavium*" var. *byzacenica* Pervinquière (1907, p. 302, Pl. XIV, fig. 4) to this group is questioned by Spath (1925, p. 199). The Madagascar specimen referred to that variety of Pervinquière's by Collignon (1931b, p. 43, Pl. V, fig. 1) differs so far in size that comparison is impossible; this is, even more, true also of Collignon's (1929, p. 37, Pl. IV, fig. 18) micromorphous (diameter, 13 mm.) *S. piveteaui* from the Cenomanian of Diego-Suarez.

Finally, a superficial resemblance between the example under examination and the large *Mammites nodosoides* var. *afra* Pervinquière (1907, p. 310, Pl. XVIII, fig. 2) from the Turonian of Tunis may be noted. The latter is, however, readily distinguishable by its entirely different suture line.

Genus **Texanites** Spath

Spath (1932, p. 379) created this genus, with *Ammonites texanus* Roemer (1852, p. 31, *pro parte*, Pl. III, fig. 1a–c only) as its genotype, only after Adkins had stated that *Ammonites vespertinus* Morton, the genotype of Meek's unfortunate genus *Mortoniceras*, was an Albian form. Owing to Meek's identification of *A. vespertinus*

and *A. texanus*, based on Gabb's authority, the former's generic name *Mortoniceras* had meanwhile been applied to *A. texanus* and to its close allies by almost all the authors dealing with this group since de Grossouvre (1893, pp. 66, 67), including Spath (1925, p. 199), Adkins (1928, p. 252) and Stanton as late as 1937 (p. 458). The writer, however, follows Spath's (1932) and Roman's (1938, pp. 460, 461) example in using the above generic name for the present group,[1] in spite of Stanton's (1937) objections to this proceeding.

That author claims that Meek had really in mind *Ammonites texanus* Roemer but not *A. vespertinus* Morton when designating the latter species the genotype of *Mortoniceras*. Spath (1938), however, asserts that Meek, when stating *A. vespertinus* and *A. texanus* to be identical, meant *A. texanus* Gabb, *non* Roemer, an Albian ammonite from the same locality as the holotype of *A. vespertinus* Morton. In consequence, there would be the less reason for transferring the generic name "*Mortoniceras*" to the Senonian group of the true *A. texanus* Roemer. Even if this assertion by Spath should be wrong, that would not alter the case. For the designation of a genotype by the author in the original publication of a genus has to be considered in a strictly formal sense (Art. 30 of the International Rules). Meek's error, as mentioned by Stanton, cannot, therefore, entitle any later author to substitute another species (*A. texanus*) for the species designated by the former. Moreover, this error seems to cast doubt on the validity of the genus *Mortoniceras* from the very outset and thus to be one more reason for the abolition of this generic name, as proposed by Roman (1938, pp. 367, 451).

It may be added that Spath included the group of *Ammonites texanus* first (1921a, pp. 232 ff.; 1922b, p. 136) in the family Prionotropidae, then (1925, p. 199) in that of the Mortoniceratidae, later (1932, p. 379) in that of the Peroniceratidae, whereas Roman (1938, pp. 460, 461) considers *Texanites* to be the youngest genus of the Prionotropidae, thus returning to Spath's first conception. In spite of Spath's (1926, p. 79) denying any relationship between the "true *Mortoniceras*" (= *Texanites*, 1932) and *Pervinquieria*, which he states to be merely "somewhat homoeomorphous," it might be doubted whether the group of *Ammonites texanus* differs sufficiently from the Albian *Pervinquieriae* to be separated generically and whether *Texanites* is not a "stratigraphic" genus rather than a palaeontological one. In the writer's opinion the first question can be answered in the affirmative and, in consequence, the second in the negative. The arrangement of the tubercles and, particularly, the outermost rows of tubercles tending to coalesce into undulate external keels accompanying the median one appear to be sufficiently distinctive generic features.

The stratigraphic range of this genus seems to be restricted to the Santonian substage of the Senonian. As to the geographic one, Basse (1931, p. 40) calls the genotype *T. texanus* an "espèce ubiquiste." Even if this statement might turn out to be exaggerated, this genus is certainly represented in both Americas and in various parts of Europe and Africa. Among the African forms there are some from Tunis, included by Pervinquière (1907, pp. 240-246, Pl. XI, figs. A, 1, 19, 20) in "*Mortoniceras, sensu stricto,*" and several interesting forms from Madagascar and the eastern part of South Africa. If among the latter "*Mortoniceras*" *woodsi* Spath (1921a, p. 232, Pl. XXI, fig. 1; Besairie, 1930, p. 637, text figs. 2/2, 3, 9, Pl. LXVII, fig. 1; Collignon, 1932, p. 35, Pl. V, fig. 2; 1938, p. 76) from Zululand and Madagascar, later chosen by Spath (1926, p. 79) as the genotype of his new genus *Submortoniceras*, and three other Madagascar species described by Collignon and probably referable to the same group, "*Mortoniceras*" *condamyi* (1932, p. 36, Pl. V, fig. 3; 1938, p. 76), "*Mortoniceras*" (*Submortoniceras*) sp. ? (1938, p. 76) and "*Mortoniceras*" (*Submortoniceras*) sp. aff. *propoetidum* Redtenbacher (1938, p. 76, text fig. F, Pl. IV, fig. 1), are left out of account, the follow-

[1] As to abolition of the generic name "*Mortoniceras*," also for the group of *Ammonites inflatus*, reference is made to the heading "Genus *Pervinquieria* Böhm" of the writer's paper referred to in the Introduction.

ing forms from South Africa and Madagascar may be considered to be true *Texanites:*

Ammonites soutonii Baily (1855, p. 455, Pl. XI, fig. 1; van Hoepen, 1921, p. 38, text figs. 19–22, Pls. X, XI; Spath, 1921a, p. 234, Pl. XX, fig. 4; 1922b, p. 136, Pl. VII, fig. 4; *non* Woods, 1906, p. 337, Pl. XLIII, fig. 1) from Pondoland and Natal;

"*Mortoniceras*" sp. aff. *soutoni* in Spath (1921a, p. 235; 1925, p. 199) from Zululand and Maputoland;

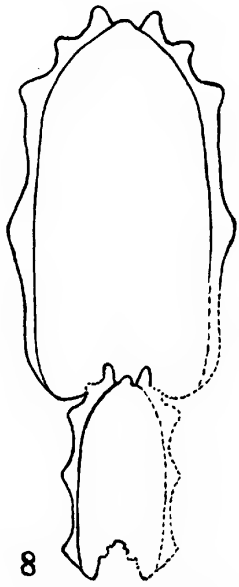


Fig. 8. *Texanites angolanus*, new species, holotype, A. M. N. H. No. 25193. Section of penultimate and last whorls, near anterior end of fragment, × 1/2.

Ammonites stangeri Baily (1855, p. 455, Pl. XI, fig. 2; Woods, 1906, p. 338, Pl. XLIV, fig. 1?; Spath, 1922b, pp. 137, 138, Pl. V, figs. 1, 2, Pl. IX, fig. 2—the latter reference including two new varieties of that species) from Pondoland;

"*Mortoniceras*" *umkwelanense* Crick (1907, p. 228, Pl. XV, fig. 9) and "*Mortoniceras*" aff. *umkwelanense* Spath (1921a, p. 234, text fig. D/2) from Zululand;

"*Mortoniceras*" *texanum* (Basse, 1931, p. 40, Pl. V, figs. 15, 16?) from Madagascar.

Among them *T. soutonii* and *T. stangeri* stand out by their large size, the former attaining up to 480 mm., the latter up to 320 mm., in diameter. It may be doubtful whether "*Mortoniceras*" *delawarense* Morton (Pervinquière, 1907, p. 243, Pl. XI, figs. 21, 22; Basse, 1931, p. 41, Pl. VI, figs. 1–4, Pl. XII, fig. 5; Collignon, 1938, p. 74) and the closely related species, "*Mortoniceras*" *australe* Besairie (1930, p. 638, Pl. LXIV, fig. 2), "*Mortoniceras*" *falloti* Collignon (1932, p. 37, Pl. V, fig. 1; 1938, p. 76) and "*Mortoniceras*" *besairiei* Collignon (1938, p. 75, Pl. IV, fig. 2), all occurring in Madagascar, "*M.*" *falloti* recorded by Collignon also from Zululand, are also referable to *Texanites*, the genotype of which is much more slender and evolute.

No species of this genus has, so far as the writer knows, hitherto been found in West Africa. In the present paper, however, three *Texanites* from Angola are described and figured: *T. angolanus*, new species; its new variety, *berryi;* and the new variety, *evoluta*, of *T. quinquenodosus* (Redtenbacher), a species first recorded from the Gosau Beds of the Austrian Alps. The two first mentioned forms attain about the size of *T. soutonii;* the last about that of *T. stangeri.*

Texanites angolanus, new species

(A) **forma typica**

Figures 8, 9, 10

A. M. N. H. No. 25193: one specimen

DIMENSIONS OF HOLOTYPE

	D	H	H′
Penultimate whorl	ca. 140 mm.	36.5	32
Outer whorl	" 300 "	ca. 35.5	32
	W	W′	U
Penultimate whorl	19.5	22.0	35
Outer whorl	20.0	23.5	43

DESCRIPTION.—The single specimen consists of about half a disc and is, despite its remarkable size, septate throughout; in consequence, the complete disc must have attained at least 440 mm. in diameter.

The conch is slender, discoidal. Its whorls increase more rapidly in height than in width. The degree of involution is low and still decreases in the outer whorl. The intercostal section (Fig. 8) is about the same in the penultimate whorl and in the outer one. The sides seem to be almost flat; up to their third quarter they converge but very slightly, thence much more decidedly, thus forming a broad-ogival venter. The umbilical shoulder is pronounced, though rounded; the umbilical wall is high and rather steep, though less so in the anterior part of the outer whorl. In both the penultimate and the outer volutions the peripheral part of the costal section is trapezoidal, the sudden increase in convergence of the sides becoming here even more obvious at the third row of tubercles. As seen

from the impressed zone of the penultimate whorl, the venter must have been fastigate in the preceding one; there the median keel seems still to have overtopped the outermost rows of tubercles, whereas in the outer volutions it becomes more and more blunt and deeply immersed between the "cockscombs" formed by the outermost tubercles.

The dominant elements of ornamentation are five concentric rows of tubercles. Those of the innermost one, situated but slightly above the umbilical edge, are, on the penultimate whorl, the strongest and sharpest, but they become less pronounced on the last. The distance between this row and the second is, in the penultimate whorl, a little greater than that between the second and the third, but, in the outer one, it becomes gradually equal to it or even slightly smaller. The tubercles of the second row are circular and not so strong on the penultimate volution, but strong and radially elongated on the last. Those of the third row mark the boundary between the flat, lateral part of the sides and the peripheral, oblique one. On the inner whorl they are about as strong as those of the second row, but they gradually become very strong in the anterior part of the outer one; in both volutions they are just a little elongated in the spiral sense. The fourth and fifth rows of tubercles cannot be studied on the next to the last volution. On the last the tubercles of the fourth row are about half way between those of the third and the fifth; they are less strong than the former and distinctly elongated spirally. The outermost tubercles are even more elongated and tend to coalesce into cockscomb-like external keels.

The tubercles of the first four rows are radially connected by what might be called ridges rather than ribs in the proper sense. There are, per half whorl, eleven on the penultimate volution and twelve on the last. In the former they begin on the umbilical wall, whence they rise in a slightly rursiradiate direction toward the circumumbilical tubercles; then they run straight and radially across the sides. On the outer whorl, however, the ribs are visible only exceptionally on the umbilical wall and they become slightly sinuous and just a little rursiradiate on the sides. It may be worth noting that in the anterior part of this volution every second rib lacks the umbilical tubercle, thus reminiscent of the ancestral difference between primary and secondary ribs. Toward the front end of the fragment increasing radial elongation of the tubercles of the first, second and, to a certain degree, even the third row causes the last ribs to appear more prominent than the precedent ones.

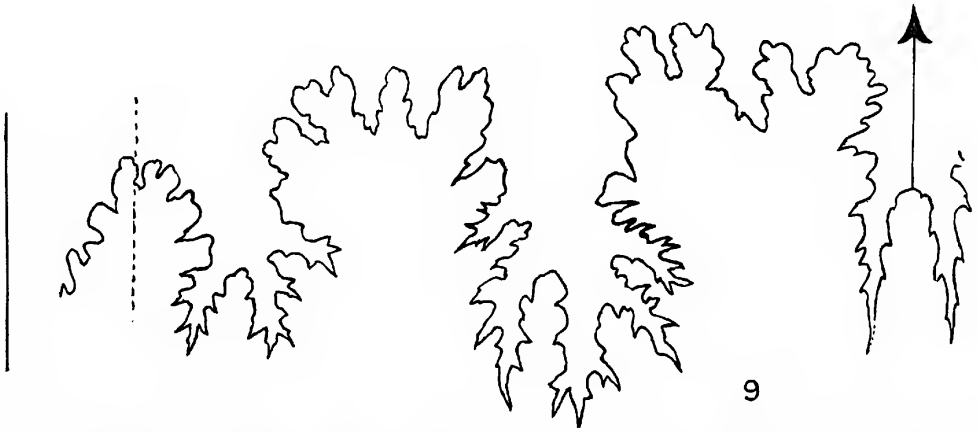


Fig. 9. *Texanites angolanus*, new species, holotype, A. M. N. H. No. 25193. Suture line at D = 280 mm., natural size; some indentations more or less coarsened by grinding.

The shell attains up to 5 mm. in thickness. On its surface fine striae of growth, running parallel to the ribs, are perceptible where preservation permits. Twenty-two to twenty-five of them can be counted in a space of 10 mm. Especially in the foremost part of the outer whorl some of those striae develop into secondary folds which run in the interstices between the ribs parallel to the latter.

The external part of the suture line could be studied, after removal of the shell, at a diameter of 280 mm. (Fig. 9). The siphonal lobe is narrow and divided by a tongue-shaped, slightly crenulated, median knob, which is half its length high, into two long and slender, almost perpendicular, terminal points. There is but one more conspicuous lateral branchlet at about the upper third of this lobe; the external saddle is very broad and subdivided by a ventrad-inclined, three-pronged lobule into two main stems, each of which is bifid; they are about equally broad, but the inner one is a little higher than the outer one. The first lateral lobe is about one and one-half times as deep as the siphonal one and

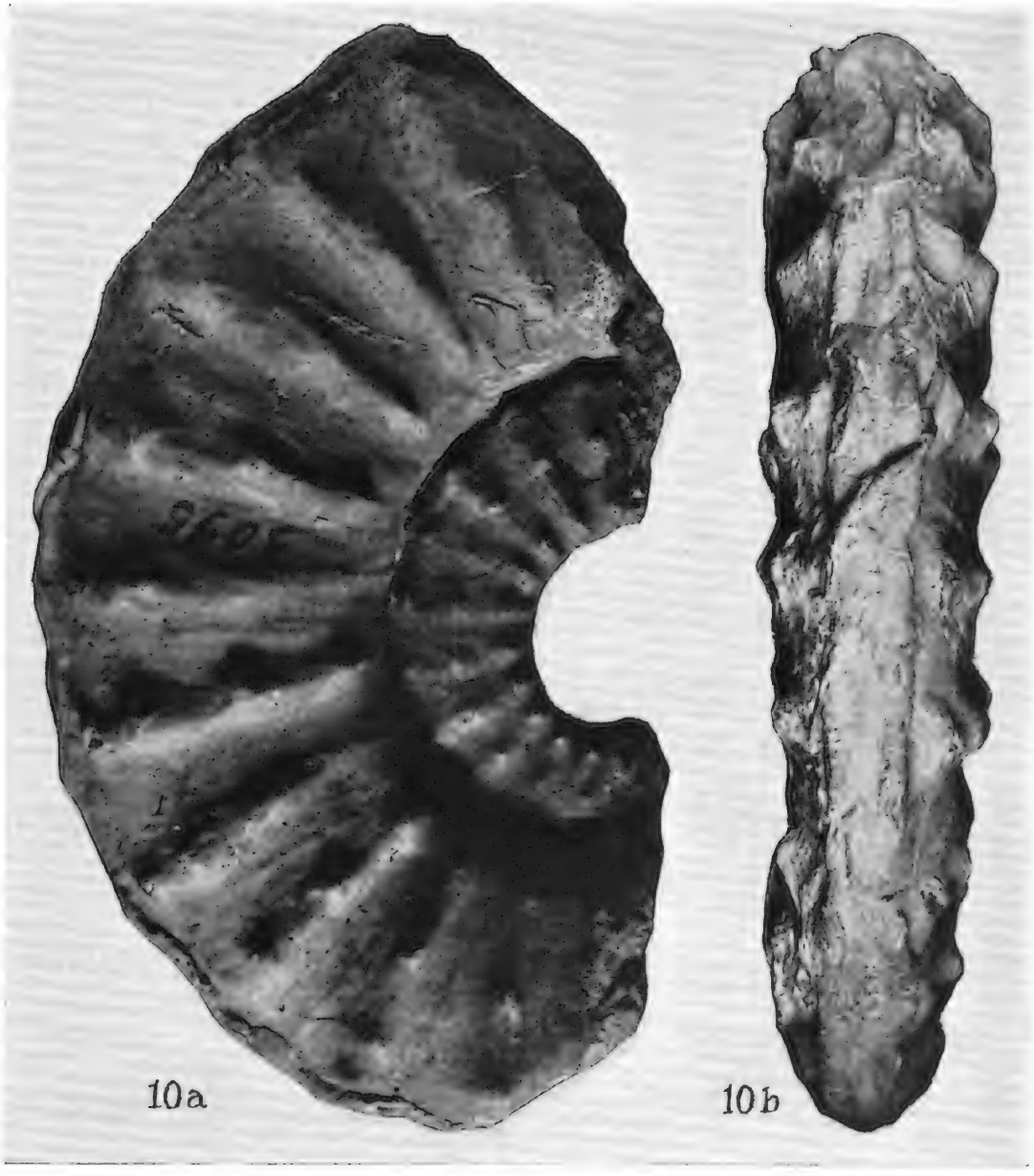


Fig. 10. *Texanites angolanus*, new species, holotype, A. M. N. H. No. 25193. (a) Right side view, (b) ventral view, showing fossil worm tubes, both × 1/2.

broader. It has at its middle a remarkably strong terminal point which is separated by a high, upright, rather richly indented leaf from another, almost equally long, but much more slender terminal point at the left side of this lobe, whereas, on the right, there are two strong, parallel, lateral branchlets above each other; the lower one is not very much shorter than the terminal points. Thus this lobe might be called bifid as well as trifid. The same arrangement is also observable in the prongs of its middle point which exhibits two terminal prongs on its left side and a strong, oblique one on the right. The other points appear to be three-pronged. The first lateral saddle is almost as broad as the external one, but somewhat lower. On its top it is subdivided into three leafs, the middle one being single, the two others bifid. The second lateral lobe is comparatively broad and attains about two-thirds of the length of the first; in the arrangement of its points it somewhat imitates the latter, there being two strong terminal points and a prominent lateral one on the right side. The second lateral saddle is far smaller than the first and subdivided, at its top, by a three-pronged lobule; its inner third is on the umbilical wall, where, besides, the outer half of an auxiliary lobe is seen. On the whole, this suture line is characterized by its broad, sturdy, little intersected saddles, reminiscent of those of some Albian *Pervinquieriae*. If the diameter is taken into account, the degree of indentation must be considered a rather low one. The peculiar dissymmetry of the main lobes, as described above, is also seen in some of Woods' (1906, Pl. XLIV, fig. 1b), van Hoepen's (1921, pp. 40, 41, text figs. 19, 21, 22) and Spath's (1921a, p. 297, text fig. D-1 a–c) drawings of suture lines of *T. stangeri* and *T. soutonii*.

OCCURRENCE.—Locality "3095," north of Cabiri.

(B) var. **berryi**,[1] new variety

Figure 11

Geological Collections, Johns Hopkins University: one specimen

DIMENSIONS OF HOLOTYPE

D	H[2]	H'[2]	W[2]	W'[2]	U[2]
ca. 280 mm.	34	ca. 31	15?	22.5	39

DESCRIPTION.—This variety is represented by a full disc; only the last quarter whorl seems to be unseptate. The specimen may have reached about the same diameter as the holotype of the typical form, at least 400 mm.

As far as the penultimate whorl could be examined, it perfectly agrees with that of the typical form. The sides of the last, however, remain flat up to the fourth row of tubercles (Fig. 11c), not to the third as in the typical form. The umbilical wall remains steep up to the anterior end, and the venter is decidedly truncate. In consequence, the section (Fig. 11c) is almost rectangular; its upper part assumes a trapezoidal shape on the body chamber only; even there this trapezoid is both lower and broader than in the typical form.

The ornamentation of the outer whorl is most distinctive of this variety. As both the typical form and the variety could be studied at the same diameters (from 215 to 265 mm.), the difference between them cannot be considered to be merely ontogenetic. In this variety the costation is much more distinct on the umbilical wall, where the ribs are very rursiradiate, and on the inner zone of the sides, where they assume a slightly sigmoidal course and where very fine striae of increment and, among them, some secondary folds are seen between, and running parallel to, the costae. Their stronger development apparently accounts for the costation seeming to be denser than in the typical form; however, there are no more than twelve ribs per half whorl, exactly as in the latter.

Furthermore, the second row of tubercles is situated farther dorsad than in the typical form, at about the inner third of the sides. The distance between the third and the second row is about the same as that between the second and the first, whereas that between the third and the fourth is only about half as long. The tubercles of the two innermost rows, particularly those of the second, are far higher than in the typical form; they grow up to 5 mm. above the level of the intercostals so as to look like steep little cones on a plain. As a further peculiarity of this variety, it is worth noting that the tubercles of the second row and, even more so, those of the third show a tendency to become elongated spirally and to form transverse ridges across the ribs which are, however, not strictly concentric in direction but trend obliquely ventrad. The tubercles of the fifth row are much lower than in the typical form, thus causing the venter to be far less concave. Also in this variety they tend to coalesce into low, undulate external keels; the median one is, on the outer whorl, extremely low and indistinct and seems to be entirely lost on the body chamber. Also the external rows of tubercles become less and less prominent in this region; thus the ventral portion of the body chamber becomes almost flat (Fig. 11c).

No continuous suture lines could be examined. It is, however, worth noting that in the outer whorl the site of the septa coincides at the periphery exactly with that of the ribs; in ventral view (Fig. 11b) the outermost tubercles always fill the terminal points of a siphonal lobe.

OCCURRENCE.—Angola, exact locality unknown.

REMARKS (AD *T. angolanus*, S. L.): Although the differences between the typical form and the variety *berryi*, as pointed out above, are quite remarkable as

[1] Named in honor of Dr. Charles T. Berry, Geological Department, Johns Hopkins University.
[2] Measured at D = 265 mm.

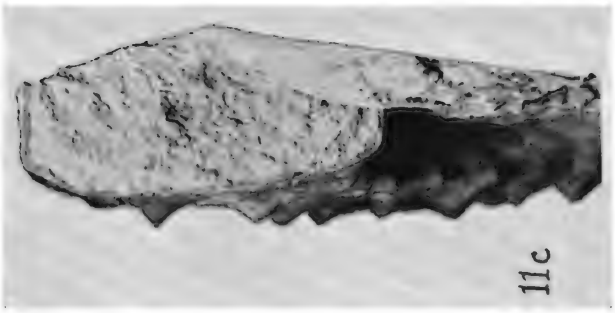
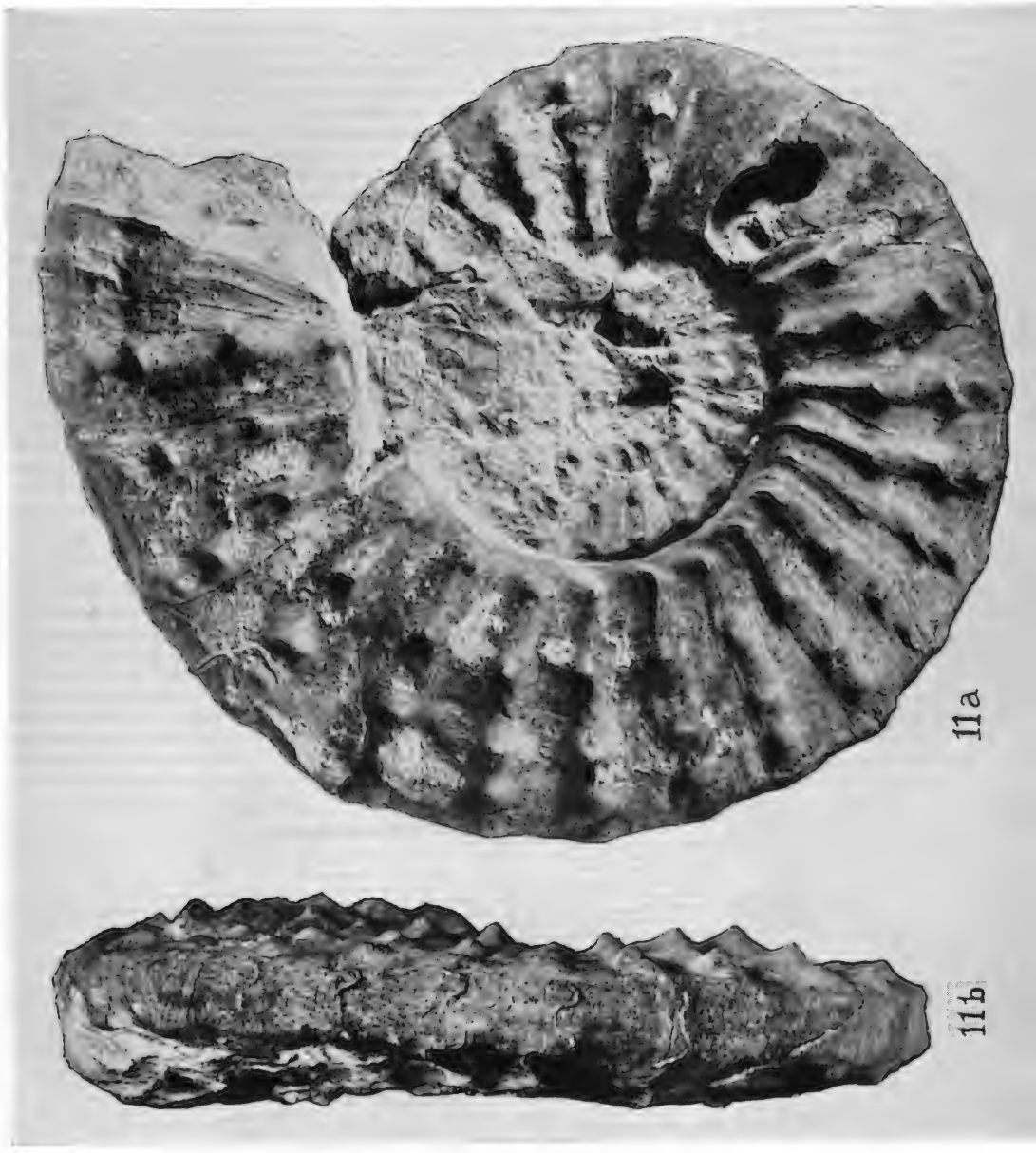


Fig. 11. *Texanites angolanus*, var. *berryi*, new variety, holotype, Geol. Coll., Johns Hopkins University. (a) Right side view, × 9/20; (b) ventral view of posterior half of outer whorl, × 1/2; (c) sectional view of body chamber at anterior end of fragment, × 1/2.



far as ornamentation is concerned, they were not considered to be of specific importance since both forms agree in general habitus, in measurements and in density of costation.

The new species is readily distinguished from the genotype *Ammonites texanus* Roemer (1852, p. 31, *pro parte*, Pl. III, fig. 1a–c only) not only by its larger size but also by its ornamentation; for whereas in Roemer's species the ribs are the dominant element of sculpture, in *T. angolanus* the nodes predominate; also the ribs are slightly less numerous in the former and they run, on the outer whorl, in an orad concave arc across the sides, whereas they are sinuous and bent slightly backward in the latter. Furthermore, the suture line of the present species differs in its broader saddles from that of *T. texanus*.

The same differences hold for the comparison of *T. angolanus* with Renz's (1936, p. 10, Pl. III, fig. 2) variety *internodosa* of *T. texanus* and with his new species *T. densinodosus* (*ibid.*, p. 8, Pl. II, fig. 1); both those forms also differ by the peculiarities of their ornamentation, as pointed out by Renz.

The form figured by Lasswitz (1904, p. 30, Pl. VII, fig. 2) under the name of *"Schloenbachia" texana*, but renamed *"Mortoniceras" roemeri* by Yabe and Shimizu (1923, p. 30; Adkins, 1928, p. 252), which the writer also believes not to be conspecific with the typical *T. texanus*, differs from the new species in being more involute, in its more numerous,[1] broader, straight ribs and in the obsolescence of the tubercles of the second and third rows on the outer whorl. It seems doubtful whether the Madagascar form named *"Mortoniceras" texanum* by Basse (1931, p. 40, Pl. v, figs. 15, 16) is really conspecific with Roemer's type from which it differs, as well as from *T. angolanus*, in being stouter and in its more dense costation. The large example referred to Roemer's species by de Grossouvre (1893, p. 80, Pl. XVII, fig. 1 only) is also remarkably thicker than those here dealt with. Its stiff and dense costation causes it to appear more closely related to *T. quinquenodosus* than to *T. texanus*. The writer cannot agree with de Grossouvre's assumption of the identity of those two species.

Stephenson's (1940, p. 69, Pl. III, fig. 1) *"Mortoniceras* aff. *M. texanum* (Roemer)" from the Upper Cretaceous Eutaw formation of Mississippi is more involute and has a denser costation and much less pronounced tubercles than both *T. texanus* and *T. angolanus*. It somewhat resembles, however, the previously mentioned *T. densinodosus* (Renz).

Finally, Schlüter's (1872, p. 41, Pl. XII, figs. 1–3) *Ammonites texanus*, very evolute and losing all its tubercles except those of the fourth and fifth rows on the outer whorl, is very different from both the above-mentioned species as well as from *T. quinquenodosus*, with which Lasswitz (1904, p. 31) quite wrongly unites it. The species under discussion will be compared later with the latter species which is here represented by a new variety, *evoluta*.

On the other hand, *T. angolanus* has its large size in common with the South African *T. soutonii* (Baily).[2] Also the measurements of the latter, as seen best in van Hoepen's (1921, p. 42) table, are not so different from those of the present species. The affinity is also indicated by the strong rursiradiateness of the ribs on the umbilical wall in both Baily's holotype and the two specimens figured by van Hoepen,[3] as well as in the holotype of *T. angolanus*, variety *berryi*. *T. soutonii* is, however, readily distinguishable from both the latter and the typical *T. angolanus* by its more dense costation and by the obsolescence of the tubercles on the outer whorl, with the result that in Baily's species the ribs instead of the nodes are the dominant elements of sculpture.

[1] Lasswitz stresses twice that the main difference between *T. texanus* and *T. quinquenodosus* is that the former has twenty to twenty-two ribs only, as compared to thirty to thirty-two in the latter. However, twenty-eight ribs can be counted on the specimen referred by himself to *T. texanus* (cf. Boese, 1910, pp. 80, 81).

[2] For synonymy, see p. 12.

[3] That author (*loc. cit.*) distinguishes a form "with broad interspaces between the ribs" and another with narrow ones. The greater density of costation in the specimen figured in his Pl. XI is, however, due to the far greater number of ribs (forty-six per whorl as compared to thirty-one in the specimen figured in Pl. X and thirty-six in Baily's holotype). Van Hoepen's first mentioned specimen ought to be separated as variety **densicostata.**

The other large South African species of this genus, *T. stangeri* (Baily),[1] is doubtless more closely related to *T. quinquenodosus* than to *T. angolanus*. For its comparison with the former species, see below.

Texanites quinquenodosus (Redtenbacher),[2] var. **evoluta,** new variety

Figure 12

Geological Collections, Johns Hopkins University: one specimen

DIMENSIONS OF HOLOTYPE

D	H	H′	W	W′	U
255 mm.	26.5	24	15.5	17	53

DESCRIPTION.—Although the single disc, the innermost whorls of which are destroyed, is not preserved up to the aperture, three quarters of its last whorl apparently belong to the body chamber, which thus must have been longer than that. In the penultimate whorl also no septa could reliably be traced, and they seem to have been destroyed.

The conch is discoidal, very slender and in maturity very evolute. Only the outermost part of the penultimate whorl is embraced by the ultimate one, but almost a third of the antepenultimate volution is embraced by the penultimate one. In this form, too, as in so many others the degree of involution strongly decreases in the course of development.

The intercostal section of the penultimate whorl (Fig. 12c, d) is lancetiform. Its sides converge decidedly toward the roof-shaped periphery which appears to have been curiously compressed and distorted by the forward growth of the outer whorl. Besides, there is a peculiar "flare" of shell, originating from the venter of the penultimate whorl, which is rather difficult to explain. If it were the remnant of a keel, that keel would have been extremely high. A keel is also seen in the visible section of the peripheral part of the antepenultimate volution; it very much overtops the external shoulders. Also the ventral region of that whorl seems to be distorted.

The intercostal section of the last whorl is elliptic-subrectangular; its sides are almost entirely flat and parallel to each other; both umbilical and latero-ventral shoulders are rounded. The inner part of the umbilical wall is perpendicular in the penultimate whorl, less steep in the last. The remarkable dissymmetry of the section, as seen in Fig. 12c, d, seems to be due in part to the somewhat unsymmetrical arrangement of ribs and nodes on both sides of the conch, and in part to crushing.

The median keel remains strong and distinct up to the front end. It is separated by two rather deep, narrow furrows from the two discontinous, cockscomb-like external keels, formed by the outermost rows of tubercles. As far as crushing does not interfere, all three of them are about equally high in the first three quarters of the outer volution. In its anterior quarter, however, the external nodes decidedly overtop the median keel.

Thirteen ribs are counted on the second half of the penultimate whorl, twenty-nine on the last. All of them are single and straight. They are, as a rule, directed radially and assume a slightly rursiradiate course on the anterior quarter of the outer volution only. There are five tubercles on each rib. On the penultimate whorl those of the first and the fourth rows are strongest, those of the third are weaker than the umbilical ones, those of the second row much the weakest. On the last whorl the tubercles of the three inner rows are about equal in strength and those of the fourth are the strongest. The innermost row is just on the umbilical edge. The distance between it and the second row is a little shorter than that between the second and the third; still longer is that between the third row and the fourth which accentuates the latero-ventral shoulder. The tubercles of this row show much more distinct spiral elongation than do those of the three inner rows, but they are less compressed than those of the fifth row, which are very narrow and tend to coalesce into sharp, though undulate, external keels accompanying the median one on both its sides.

No suture lines could be examined.

OCCURRENCE.—Angola, exact locality unknown.

REMARKS.—Except for being more evolute (U = 63 as compared to 44.5 and 45, respectively), this specimen agrees fairly well with both Redtenbacher's holotype of *Ammonites quinquenodosus* and von Hauer's example, figured in Figs. 4–6 of his Pl. II and referred by the former author to his species.[3] Even the detail that the ribs of the outer whorl become slightly rursiradiate toward the anterior end is found in Redtenbacher's type as well as in the present one. The African form is, however, much larger than the Austrian one. The latter must also have been very slender, even if allowance is made for its being crushed. It is true that von Hauer's specimen is considerably thicker (W′ = 24 in Fig. 4, not 30 as asserted in the de-

[1] For synonymy, see p. 12.

[2] 1873, p. 108, Pl. XXIV, fig. 3; synonym: von Hauer, 1858, p. 10, Pl. II, figs. 4–6.

[3] For references, see p. 18, footnote 2; other quotations of this species: de Grossouvre, 1893, pp. 80–83; Lasswitz, 1904, p. 31; Yabe and Shimizu, 1923, p. 30.

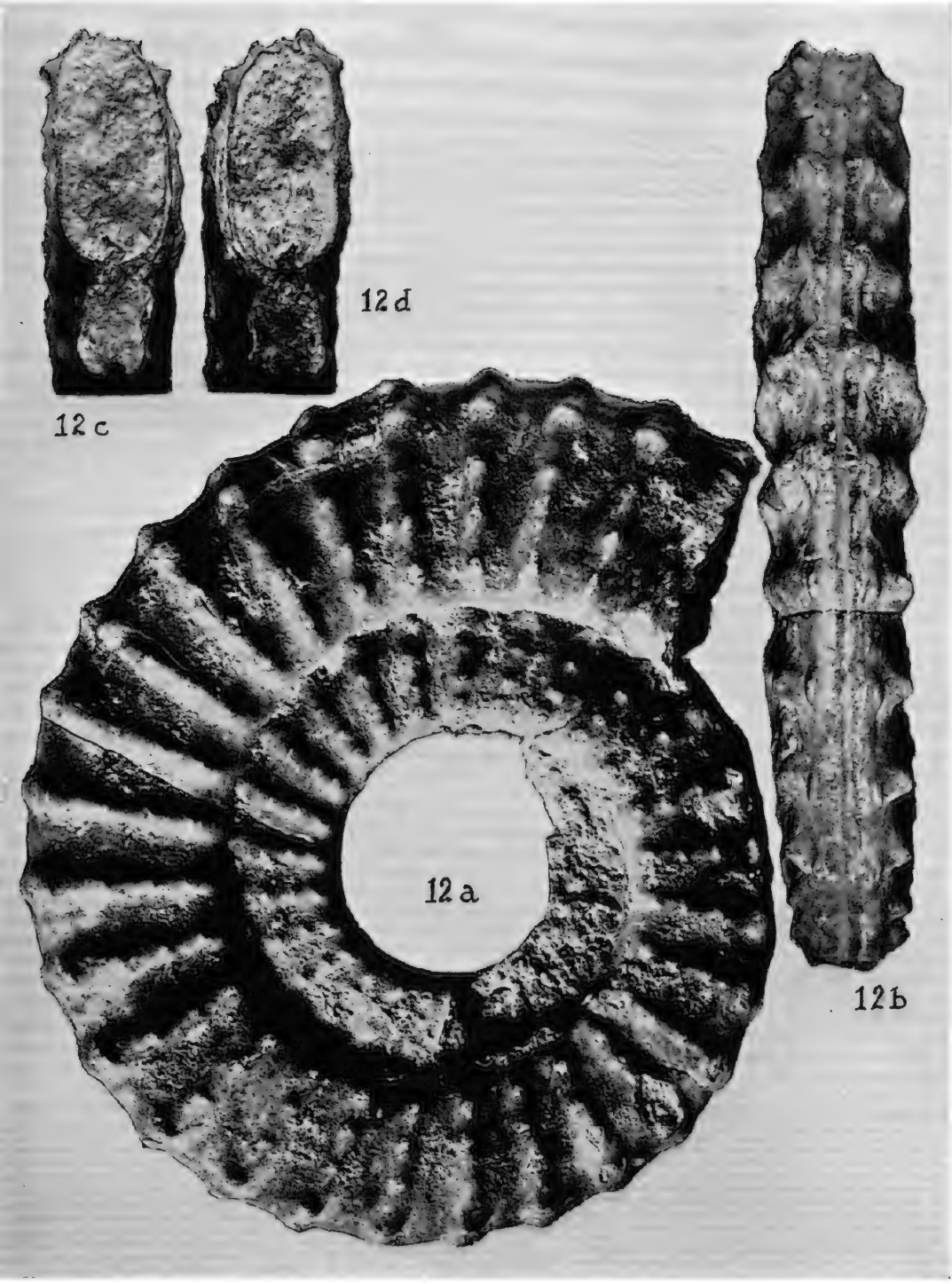


Fig. 12. *Texanites quinquenodosus* (Redtenbacher), var. *evoluta*, new variety, holotype, Geol. Coll., Johns Hopkins University. (a) Right side view, (b) ventral view, (c, d) sectional views at both sides of last fracture, all × 1/2.

scription) than Redtenbacher's type, but this may be due to its smaller size.

From the genotype, *T. texanus*,[1] *T. quinquenodosus* differs not only by being more slender and by its denser costation, but also by the stiffness of the latter. The variety under discussion is, also, much more evolute. From the other Angolan species of this genus, *T. angolanus*, and its variety *berryi*, both the typical *T. quinquenodosus* and its variety *evoluta* can readily be distinguished by their more compressed conch, by their more distinct median keel, which does not fade on the body chamber, and, above all, by the different character of ornamentation: in the former the tubercles prevail, in the latter the costae with the costation being more dense and stiffer.

The form under discussion is, especially in its sculpture, rather similar to that erroneously referred to *T. soutonii* (Baily)[2] by Woods (1906, p. 337, Pl. XLIII, fig. 1), which seems to be more closely related, particularly as to ornamentation, to *T. quinquenodosus* than to Baily's species which loses its tubercles almost entirely on the outer whorl. Woods' form differs, however, from that here dealt with in being thicker and more involute. The other large South African *Texanites*, *T. stangeri* (Baily),[2] still more resembles *T. quinquenodosus;* it is even more evolute than the present form, but it has a more rounded section, a broader venter with a stronger and more prominent median keel and less pronounced and less stiff but more numerous ribs which bifurcate almost regularly up to the penultimate whorl.

STRATIGRAPHIC RÉSUMÉ OF LOCALITY "3095"

Only two of the four specimens bearing the above field locality number could be given a specific name: *Sharpeiceras goliath*, new species, and *Texanites angolanus*, new species. However, neither could be identified with any known species, and they are therefore of no more value for correlation purposes than the two other specimens which were determined merely genetically as *Acanthoceras* (*Romaniceras*), spec. indet., and *Mantelliceras* (?), spec. indet.

Nevertheless, the generic determinations are sufficient for correlation of these four ammonites to certain stages of the Upper Cretaceous. Even the fact that the last form could not be referred to its genus with full certainty is without any stratigraphic significance, as the other genus, *Metacalycoceras*, to which it might be referred, is also a Cenomanian one.

The Turonian, the next stage of the Upper Cretaceous, is represented at locality "3095" by a specimen which, although not determined specifically, was referred to the group of *Ammonites deverianus* d'Orbigny (= genus *Romaniceras* Spath); this group is, according to all records available, restricted to this stage.

The genus *Texanites* Spath, including the Senonian "*Mortoniceras*" of the group of *Ammonites texanus* Roemer, appears to be restricted to the Santonian substage of the Senonian.[3] Thus this age can be assigned to *Texanites angolanus*, new species, from "3095" and to the two examples of the Johns Hopkins collections, the exact locality of which is unknown, but which obviously belong to the same genus, one of them even to the same species (*s. l.*): *Texanites angolanus*, variety *berryi*, and *Texanites quinquenodosus*, variety *evoluta*.

As far as locality "3095" is concerned, the question arises whether or not all four examples, representing three stages of the Upper Cretaceous, were collected from the same bed. Unfortunately no field data which would decide this issue are available. In consequence, both alternatives must be considered:

(a) If these ammonites come from different horizons, though from the same locality, it will mean only that the Upper Cretaceous from the Cenomanian up to the Middle Senonian is exposed there.

(b) If, on the other hand, they have

[1] For references, see p. 17.

[2] For synonymy, see p. 12.

[3] It seems that the horizons of the Austin Chalk of Texas which bear several species of *Texanites* have also to be referred to the Santonian.

been collected from the very same bed, the latter would have to be considered of Middle Senonian age, and secondary deposition of the Cenomanian forms and of the Turonian one would have to be assumed. This would agree fairly well with the relative states of preservation: that of the *Texanites* is by far the best, the shell being fully preserved and even exhibiting striae of growth; that of the Turonian *Acanthoceras* (*Romaniceras*) is poorer, its surface being deprived of the test and rather worn, and the surfaces of the two Cenomanian ammonites, *Mantelliceras* (?) spec. indet., and *Sharpeiceras goliath*, are still more worn. Furthermore, it must be kept in mind that such a large conch as the *Sharpeiceras*, weighing actually almost 27 lbs., could have stood the transport to a place of secondary deposition only after fossilization.

In the case of locality "3095" this state of preservation would support the surmise that the older fossils had been reworked, whereas that of the ammonites from Salinas, collected, according to Douvillé (1931, pp. 21, 44), in a single bed not thicker than 40 cm., does not agree with such a surmise, since Douvillé asserts that all the fossils are "en bon état et ont presque toujours conservé leur test." As he (p. 44) refers them to various stages of the Cretaceous from the Barremian up to the Turonian, the problem is to him an unsolvable one.

Two other authors, however, have tried to solve this riddle in quite different ways. Spath (1931, p. 316), on the one hand, questions Douvillé's taxonomic identifications and, in consequence, also his age determinations. He considers all but one of the forms from Salinas to be Cenomanian, thus assuming a Cenomanian age for that assemblage. To Bonte (1939, p. 687), on the other hand, this case is a classical example of "remaniement," in spite of Douvillé's assertions to the contrary.

In any event the Cenomanian, Turonian and Middle Senonian (Santonian) ammonites found north of Cabiri, a village about 45 km. east southeast of Loanda, considerably reinforce the ammonitological evidence of the presence of Upper Cretaceous deposits of these stages in northern Angola. Choffat (1905, pp. 29–31), Haughton (1924, pp. 80, 81), Mouta and Borges (1928, pp. 917–927), Rennie (1929, pp. 4–9) and Mouta (1938, p. 33) record Upper Cretaceous deposits from northern Angola. Choffat (1905, p. 30) mentions a *Baculites* from Senza do Itombe, and Haughton (1924) lists a considerable number of ammonites from various localities: some doubtfully determined as Turonian by Spath, from east of Cabo Ledo; *Phylloceras surya*, *Baculites* sp. and *Placenticeras reineckei* Haughton from some other localities south of Loanda; a Senonian, perhaps Campanian, assemblage, including *Menuites mcgowani* Haughton, *Libycoceras angolense* Haughton, *Nostoceras angolense* Haughton, *Didymoceras hornbyense*, *Didymoceras* sp., *Bostrychoceras polyplocum*, *"Oxybeloceras" binodosum* Haughton and *Baculites subanceps* Haughton, from Carimba, and *Diplomoceras* ? cf. *indicum*, apparently of the same age, from another locality. Except the Turonian ones, these forms are described, and most of them figured, in Haughton's paper. Two more mentions of Upper Cretaceous ammonites from northern Angola are found in literature: Spath's (1921b, p. 56) of a small collection of Nostoceratidae (*Didymoceras*) from the Barra do Dande, and Thiele's (1933, p. 112)[1] of an *Acanthoceras* of the *cunningtoni*-group (= genus *Cunningtoniceras* Collignon, 1937, p. 64), referred to the Upper Cenomanian, and of *Mammites conciliatus* (Stoliczka), referred to the Turonian, from Novo Redondo. The Salinas ammonites described by Douvillé (1931) are, however, from southern Angola.

The palaeontological evidence from both Salinas and locality "3095" strongly supports (if minor oscillations of the sea level are left out of account) Spath's (1921b, p. 56) inference, drawn from the Turonian and Coniacian faunas of Nigeria and the Cameroons, "that the Western arm of the Thetys, down to Angola, probably continuously existed from Albian [to Campanian] times," and refutes Gregory's (1922, p. 163) conception to the contrary,

[1] Referred to by Jessen (1936, p. 38).

"that the sea had withdrawn mainly if not wholly from the coast of Angola during the Cenomanian, Turonian and Lower Senonian," as well as Haughton's (1924, p. 83) belief in an interruption of deposition during the Cenomanian and a part, at least, of the Turonian, and Rennie's (1929, p. 9) supposition of "Turonian deposits being probably absent from Angola."

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